REMARKS

Claims 1-7 and 19-30 are pending in this application, of which claims 27-30 have been newly added. Reconsideration of the rejections in view of these amendments and the following remarks is respectfully requested.

Rejections under 35 U.S.C.§103(a)

Claims 1 and 7 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Uglow et al (U.S. Patent No. 6,251,770) in view of Chung et al (U.S. Patent No. 6,184,142).

Applicants respectfully traverse this rejection.

In response to Applicants' previous response, the Examiner has alleged that "Applicant's arguments are directed to the method of making the devices of Uglow et al. and Chung et al. It is noted that the claims are directed to a devices themselves not to the method of making . . . ." The present claims, however, do recite specific structural recitations of the device which Uglow et al. and Chung et al. do not teach or suggest.

Claim 1 recites "wherein said interlayer insulating film includes **a first kind of an insulating layer surrounding said side wall and said bottom surface of said wiring trench** and a second kind of an insulating layer disposed under said first kind of the insulating layer and having etching characteristics different from said first kind of the insulating layer," and "wherein said **contact hole has an upper portion whose cross sectional area gradually increases toward an upper level** and reaches said **bottom surface of said wiring trench** in said first kind of the insulating layer."

The Examiner appears to allege that the slanted portion in Chung et al corresponds to "contact hole has an upper portion whose cross sectional area gradually increases toward an upper level." However, Assuming, *arguendo*, that the slanted portion corresponds to "contact hole has an upper portion whose cross sectional area gradually increases toward an upper level," Chung et al does not have "a first kind of an insulating layer surrounding a side wall and the bottom surface of said wiring trench." In Chung et al, "contact hole has an upper portion whose cross sectional area gradually increases toward an upper level,"cannot coexist with "a first kind of an insulating layer surrounding a side wall and the bottom surface of said wiring trench." In this sense, Chung et al, teaches away from combining these elements.

Also, Uglow et al and Chung et al does not show any suggestion or motivation to modify the reference or to combine reference teachings. As already mentioned, Chung et al, teaches away from combining the elements. Although the Examiner has alleged that "it would have been obvious to one of ordinary skill in the art to use contact hole having a gradual increase toward an upper level as Chung et al," the Examiner has not explained how one of ordinary skill in the art would be motivated to do so.

Moreover, there is no reasonable expectation of success to combine Uglow et al and Chung et al. Chung et al does not disclose how the slanted surfaces are formed. Also, it does not disclose how the slanted surface is formed in the trench or the via hole of Uglow et al. There cannot be any reasonable expectation of success making the combination without these teachings. Moreover, even when Uglow et al and Chung et al are combined the claimed invention is not obtained, to the extent of meeting the limitations of "wherein said interlayer insulating film includes **a first kind of an insulating layer surrounding a side wall and the bottom surface of said wiring trench** and a second kind of an

insulating layer disposed under the first kind of the insulating layer and having etching characteristics different from the first kind of the insulating layer," and "wherein said **contact hole has an upper portion whose cross sectional area gradually increases toward an upper level** and reaches the **bottom surface of said wiring trench** in the first kind of the insulating layer."

To establish a *prima facie* case of obviousness, three basic criteria must be met: (1) the prior art reference (or references when combined) must teach or suggest **all the claim limitations**; (2) there must be some **suggestion or motivation** either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings; and (3) there must be a **reasonable expectation of success**. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

As discussed above, the Office Action has not met any of the three requirements and has not established a *prima facie* case of obviousness.

The following is a more detailed explanation.

Uglow et al. describes that the dual damascene techniques includes (i) via first fabrication, (ii)self-aligned fabrication, and (iii) trench first fabrication (column 4, lines 7-17). In the embodiment of Uglow et al., the trench is etched first (column 6, lines 24-36). The resultant shape as shown in Fig. 10B having a trench in the low k dielectric material layer 106' and a via (contact hole) extending from the bottom of the trench with a right-angled shoulder in the layer 106' through the remaining depth of the low k material layer, the dielectric layer 104' and the barrier (etch stopper) layer 102' to the underlying conductive surface

122. This shape is unique to the trench first fabrication using a mask for etching a via as shown in Fig. 4. There is no disclosure how two other technologies are performed to produce what structures.

Chung et al. discloses dual damascene fabrication in Figs. 3A-3G. Patterned hard mask layers 17, 18 and 14, 15 are formed on the low k material layers 12 and 13. Column 2, lines 22-27 reads "dual damascene structure is formed by anisotropically etching low k organic dielectric films 13 and 12, as shown in Fig. 3F." followed by " Cross section of dual damascene structure is formed after metal barrier layer and metal layer deposition in sequence and etching excess metal by using chemical mechanical polishing method." These fabrication processes correspond to the above-mentioned self-aligned fabrication. Fig. 3F shows the step of anisotropic etching. The etching proceeds from the upper surface to the lower position. The etching of the low k layer 13 will be stopped by the etch stopper layers 17, 18, but there is no reason that the left trench has slanted side walls, while the right trench has vertical side walls. Anisotropic etching is known to produce vertical side walls as shown in the right trench. When the narrow right trench is etched vertically to the hard mask layers 17, 18, the wide left trench should also be etched vertically to the hard mask layers 17, 18. Therefore, it is impossible to form vertical side walls and slanted side walls by the same etching process. Chung et al. lacks the enabling disclosure for producing a trench whose cross sectional area gradually increases toward an upper level.

Moreover, the low *k* layer 13 covered with the hard mask layers 14, 15 are for the trench. The via (contact hole) is the opening portion formed in the hard mask layers 17, 18 and the underlying low *k* layer 12. When the damascene wiring is seen in plan view, the via is a hole of limited area, and the trench is an elongated wiring which extends from one connection to at least another connection. The contact hole

formed in the hard mask layers 17, 18 and the low *k* layer 12 has no upper portion whose cross sectional area gradually increases toward an upper level.

Furthermore, the first-trench fabrication of Uglow et al. and the self-aligned fabrication of Chung et al are not compatible.

Applicants' invention solves the problem found in **first-via fabrication** without using an etch stopper layer between the trench level and the via level. The conventional method of first forming a via hole and then forming a wiring trench using an etch stopper layer between the trench level and the via level is illustrated in Figs. 11A to 11F of the present drawings. When the etch stopper between the trench level and the via level is omitted and a via hole is first formed, there arises a problem as described in the applicant's specification pages 11-14, referring to Figs. 13A-16D. Namely, abnormal etching occurs, due to the etching of shoulder formed by the bottom of the wiring trench and the side wall of the via hole (see specification, page 11, line 17 to page 12, line 1). When the trench etching is done on a structure already formed with a via hole, etching can occur also from the side surface of the via hole. Such etching produces the diverging portion at an upper portion of the via (contact) hole.

When a via hole is etched after a trench is etched, there occurs no such shoulder etching because the via is etched in a flat bottom surface of the trench using a mask. Even when via is formed first, if an etch stopper layer is used between the trench level and the via level, there is no shoulder etching as illustrated in applicant's Figs. 11A-11F.

For at least these reasons, claim 1 patentably distinguishes over Uglow et al and Chung et al. Claim 7, depending from claim 1, also patentably distinguishes over Uglow et al and Chung et al for at least the same reasons.

Thus, the 35 U.S.C. §103(a) should be withdrawn.

Claims 3-6 and 26 stand rejected under 35 U.S.C. §103(a) as being obvious over Uglow et al in view of Tsai et al (U.S. Patent No. 6,319,814 B1).

Applicants respectfully traverse this rejection.

Claim 3 depends from claim 1. Tsai et al has been cited for allegedly disclosing a third kind insulating layer under the second insulating layer. Such disclosure, however, does not remedy the deficiencies of Uglow et al discussed above.

Moreover, Tsai et al discloses another self-aligned fabrication using a patterned etching stop layer 214 (column 3, line 62 to column 4, line 3, and column 4, lines 31-42). Use of an etching stop layer between the trench level and the via level will produce no shoulder etching. Tsai et al teaches the use of laminated dielectric layers of different etching characteristics. The self-aligned fabrication of Tsai et al. is not easily combined with the first-trench fabrication of Uglow et al.

For at least these reasons, claim 3 patentably distinguishes over Uglow et al and Tsai et al. Claims 4-6, depending from claim 3 also patentably distinguishes over Uglow et al and Tsai et al for at least the same reasons.

Thus, the 35 U.S.C. §103(a) should be withdrawn.

Claims 19-24 stand rejected under 35 U.S.C. §103(a) as being bvious over Uglow et al in view of Chung et al.

Applicants respectfully traverse this rejection.

As discussed above, the slanted surface of Chung et al is a side wall, or side-wall/bottom of the wiring trench. Chung et al discloses no separate bottom surface of the wiring trench and shoulder portion of the via hole.

For at least these reasons, claims 19-24 patentably distinguishes over Uglow et al and Chung et al.

Thus, the 35 U.S.C. §103(a) should be withdrawn.

In view of the aforementioned amendments and accompanying remarks, claims, as amended, are in condition for allowance, which action, at an early date, is requested.

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

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